ONE PIECE DECORATIVE INSULATION AND INTERIOR PANEL ASSEMBLY

FIELD OF THE INVENTION

[0001] The present invention relates in general to insulation and more specifically to insulation systems for mobile platforms.

BACKGROUND OF THE INVENTION

[0002] Insulation systems for modern mobile platforms are typically installed having at least one layer of insulation material connected to the inside facing surface of an outer shell of the mobile platform. Both to protect the insulation layer and to provide a durable working surface, a separate layer of rigid or semi-rigid material is then placed over the insulation layer and fastened to the structure of the mobile platform. The insulation is required where the mobile platform is required to operate in low-temperature applications and also provides a sound barrier. For purposes of illustration only, insulation systems applied to commercial aircraft will hereinafter be described in reference to the mobile platform.

[0003] Modern commercial aircraft are constructed having a thin outer skin and a plurality of internal frames or ribs supporting the skin. Because the aircraft is exposed during operation to extremely low external temperatures, insulation is applied to the interior facing surfaces of the outer skin. Insulation on commercial aircraft is typically applied in one of two ways. In a first method, insulation is applied directly to the outer skin on the inner facing edge of the skin. In a second method, insulation is applied to the outer facing surfaces of the interior cabin wall panels attached to the frames of the aircraft. To protect the insulation and provide a sealed, durable, and decorative interior surface, commercial aircraft commonly install rigid or semi-rigid composite wall sections over the insulation layer(s).

[0004] The above methods to both insulate and seal the exterior skin of commercial aircraft have several disadvantages. Installation of the one or more insulation layers requires separate installation steps from that used to later install the layer of composite over the insulation. This increases the overall labor cost to

manufacture each aircraft. Further, the composite walls that are used require individual tooling to shape the composite walls to conform to the shape of the aircraft adjacent to the frames and structural components. In addition, because it is undesirable for fasteners used to mount the composite walls to be visible following installation, fasteners to mount the composite walls are typically provided on exterior facing surfaces of the composite walls. Providing fasteners in these locations requires that the fasteners be pre-aligned with support structure of the aircraft. Due to the rigid nature of the composite wall surfaces, any misalignment of the fasteners requires additional time and expense during the insulation process to provide proper alignment and installation of the wall. Additional cost is also incurred by the separate tooling required for the composite wall sections to accommodate the variety of geometry changes in a commercial aircraft due to bulkhead wall locations, overhead luggage compartment locations, and both window and emergency exit locations. Unique tooling is also required for NC trimming of the composite part and also for vacuum forming the decorations in or on the surface of the composite part. This variety of molding tools adds further expense to the construction cost of each aircraft.

[0005] It is therefore desirable to provide an insulation system and a method of installation which overcomes the disadvantages noted above. It is also desirable to decrease the number of individual components required to insulate a mobile platform.

SUMMARY OF THE INVENTION

[0006] According to a preferred embodiment of the present invention, a one piece insulated wall for a mobile platform is provided. The one piece insulated wall includes a first layer having insulation material. A second layer includes a flexible material having an outer face defining a decorative pattern and an inner face attached to the first layer. The one piece insulated wall is mountable in the mobile platform such that the outer face of the second layer defines an innermost facing surface.

[0007] In another preferred embodiment of the present invention, a plurality of composite mounting fasteners are each connected at a fixing end to only the first layer. Each of the fasteners includes a distal connecting end freely

extending from the first layer in a direction facing away from the second layer. The distal connecting end operates to connectably join the wall to the mobile platform.

[0008] In still another preferred embodiment of the present invention, a mobile platform comprises an exterior skin defining at least one interior compartment. A composite wall is conformable to a shape of the exterior skin and connectable to the exterior skin within the interior compartment. The composite wall includes at least one insulation layer and a flexible layer attachable to the insulation layer. The flexible layer operably forms an interior boundary surface of the interior compartment when the composite wall is connected to the exterior skin having the insulation layer facing the exterior skin.

[0009] In yet another preferred embodiment of the present invention, a method of insulating a compartment of a mobile platform is provided. The method uses a one piece insulated wall having a flexible material layer attachable to an insulation layer. The method steps include forming a decorative pattern on a first face of the flexible material layer. The insulation layer is attached to a second face of the flexible material layer. The decorative pattern is then oriented toward the interior compartment of the mobile platform. Finally, the insulated wall is connected to the mobile platform having the insulation layer facing an exterior surface of the mobile platform.

[0010] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0012] Figure 1 is a fragmentary perspective view of an insulation system according to a preferred embodiment of the present invention installed within an exemplary aircraft body;

[0013] Figure 2 is a perspective view of an insulation panel of the present invention identifying the insulation and the flexible layers of the present invention;

[0014] Figure 3 is a fragmentary perspective view of an insulation bag containing insulation batting according to another preferred embodiment of the present invention;

[0015] Figure 4 is a partial cross-sectional view taken at Section 4-4 of Figure 1;

[0016] Figure 5 is a partial cross-sectional view similar to Figure 4 identifying an alternate embodiment for the insulation layers of an insulation panel of the present invention;

[0017] Figure 6 is a partial perspective view identifying an exemplary installation procedure for an insulation panel of the present invention;

[0018] Figure 7 is a partial cross-sectional view showing an exemplary fastener installed through an insulation panel and aligned with a fastener retention aperture of the present invention;

[0019] Figure 8 is a partial cross sectional view of another embodiment for attaching insulation panels of the present invention without fasteners; and

[0020] Figure 9 is a flow diagram of the steps to insulate a compartment of a mobile platform using a one-piece insulated wall of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] The following description of the preferred embodiments is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0022] According to a preferred embodiment of the present invention, an insulation system 10 includes an insulation panel 12 having a first layer 14 and a second layer 16. First layer 14 includes at least one layer of insulation material. Second layer 16 is constructed from a flexible material such as a cloth or polymeric material which together with first layer 14 can be formed into a coiled roll (shown and described in reference to Figure 6).

[0023] Second layer 16 preferably includes a decorative pattern 18. Decorative pattern 18 can be applied to second layer 16, embossed onto second layer 16, integrally formed with second layer 16, or formed as a colored or textured surface of second layer 16. Examples of decorative pattern 18 include a faux leather appearance, geometry patterns, or random patterns. Second layer 16 also includes a plurality of apertures 20 formed through an entire thickness of insulation panel 12. Apertures 20 will be described in further detail in reference to Figure 6.

[0024] Insulation panels 12 are installed at exterior surfaces of a mobile platform 21. For exemplary purposes only, mobile platform 21 is depicted herein as a portion of a commercial aircraft. After installation of one or more insulation panels 12, each of a plurality of trim pieces 22 are installed adjacent each aperture 20. Trim pieces 22 act to both seal the insulation panel 12 adjacent to apertures 20 and provide an aesthetically pleasing final appearance for insulation panel 12. Insulation panel 12 is typically installed to structure adjacent to an outer skin 24 of mobile platform 21. Figure 1 shows this structure as a plurality of frames 26 and a plurality of frame cross members 28 connectably joined to outer skin 24. In a typical installation, insulation panel 12 is releasably fastened to frame cross members 28, such that insulation panel 12 conforms to a general shape including any curvature of frames 26 and frame cross members 28.

[0025] As best seen in Figure 2, insulation panel 12 includes first layer 14 attached to second layer 16. Second layer 16 includes an inner face 30 and an outer face 32. Outer face 32 further includes a perimeter region 34. In a preferred embodiment, first layer 14 is attached to perimeter region 34 only. The advantage of attaching first layer 14 to perimeter region 34 only is to avoid wrinkling of second layer 16 during installation of insulation panel 12, particularly where installation is about a curved surface area or a generally non-planar surface area. First layer 14 can be attached to second layer 16 using any known bonding material including adhesives, adhesive tape, or epoxy; by sewing; by mechanical connection or joining; or by using any of a variety of chemical joining agents that are compatible with the materials of first layer 14 and second layer 16, respectively. Attachment of first layer 14 to second layer 16 is preferably a permanent connection, but can also be a non-permanent type connection.

[0026] In the embodiment shown in Figure 3, first layer 14 includes one or more layers of fiberglass insulation batting. To contain each of the layers of insulation batting, first layer 14 is enclosed within a polymeric film 36 which forms an insulation bag 38. Polymeric film 36 is attached to perimeter region 34 (shown in Figure 2) to join the insulation bag 38 to second layer 16.

[0027] As best seen in reference to Figures 4 and 5, two preferred embodiments of the present invention are shown. In Figure 4, exemplary frames 26 joined to outer skin 24 provide mounting surfaces for frame cross member(s) 28. Insulation panel 12 is connectably mounted to frame cross member 28 as shown, having first layer 14 adjacently positioned to frame cross member 28 and second layer 16 oriented toward a mobile platform interior facing direction of arrow "A". Second layer 16 thereby forms an inner-most boundary wall within mobile platform 21. As shown in Figure 4, between each adjacent pair of frames 26 an inter-frame cavity 40 is formed. In the embodiment shown, the entire insulation panel 12 is disposed inboard of inter-frame cavity 40 and generally forms an outer wall of an inner compartment 42.

[0028] In the further embodiment shown in Figure 5, cavity insulation 44 extends from first layer 14 between adjacent frame cross member 28 to at least partially fill each inter-frame cavity 40. In this embodiment, cavity insulation 44 does not contact outer skin 24, to avoid trapping moisture between the outer skin 24 and cavity insulation 44. Cavity insulation 44 can also extend to contact outer skin 24, if appropriate known systems of moisture removal are used. The embodiment of Figure 5 can result from compression of insulation adjacent to frame cross member 28 or alternately by providing additional insulation between known location(s) of frames or cross members.

[0029] Figure 6 identifies an exemplary installation process for insulation panel 12 according to a preferred embodiment of the present invention. Insulation panel 12 is first formed in a coiled roll 46. Coiled roll 46 is transported to the mobile platform installation area and thereafter unrolled in the uncoiling direction arrow "B" as shown. Each of the apertures 20 formed in insulation panel 12 are positioned to correspond with each of a plurality of window apertures 48 disposed in outer skin 24. As insulation panel 12 is uncoiled as shown, apertures 20 are aligned with each of the window apertures 48 and a

plurality of fasteners 50 are each aligned with a plurality of fastener apertures 52 formed in frame cross member 28. Fasteners 50 each freely extend from insulation panel 12 from the outer face 32. As shown in Figure 6, fasteners 50 do not extend through inner face 30 of second layer 16. This ensures that following installation of installation panel 12, fasteners 50 are not visible to passengers within the inner compartment 42. Each fastener 50 is releasably connected with mating ones of the fastener apertures 52 to connect insulation panel 12 to mobile platform 21 (shown in Figure 1).

[0030] As best seen in Figure 7, an exemplary fastener 50 is shown in an installed position in insulation panel 12. Fastener 50 shown in Figure 7 is exemplary in that a plurality of fastener designs can be used without departing from the gist of the present invention. In the embodiment shown, fastener 50 includes a first flange 54 having a generally tapered cross section to allow installation of fastener 50 through first layer 14. As shown in Figure 7, first flange 54 does not penetrate second layer 16 but merely abuts second layer 16. Fastener 50 further includes a second flange 56 generally located at a distal surface of first layer 14. A body stem 58 spaces fastener 50 throughout a width or thickness of first layer 14. Fastener 50 thereby forms a fixing end 60, fixing fastener 50 to first layer 14, and a connecting end 62, which distally extends from first layer 14 opposite to second layer 16.

[0031] To install an insulation panel 12 of the present invention, a plurality of fasteners 50 are first installed in insulation panel 12. Each fastener 50 has its connecting end 62 aligned with a mating one of fastener apertures 52 formed in frame cross members 28. Fastener 50 is thereafter pressed in the fastener installation direction "C" until bulbous ends 64 of fastener 50 compress in the fastener compression direction "D" in fastener aperture 52 to allow bulbous end 64 to pass within fastener aperture 52. A spring force of fastener 50 at connecting end 62 thereafter expands bulbous ends 64 to releasably retain fastener 50 in contact with frame cross member 28.

[0032] Figure 7 also identifies that first layer 14 can be formed from two (or more) layers of insulation material. Figure 7 shows a first insulation layer 66 and a second insulation layer 68. First insulation layer 66 and second insulation layer 68 can be formed of the same or dissimilar insulation materials. For

example, first insulation layer 66 can be formed of a fibrous glass material insulation and second insulation layer 68 can be formed of a foam insulation material. The invention is not limited by the insulation material(s), providing each insulation material permits installation of an insulation panel of the present invention on curved or non-planar surfaces, as well as on planar surfaces.

[0033] In an alternate embodiment (not shown), fastener 50 can be formed as a known male type metallic or polymeric snap fastener. Fastener aperture 52 is replaced in this embodiment with a female snap fastener element to receive the male snap fastener element installed on the first layer 14. Elements of the snap fastener can also be reversibly attached, having the female snap fastener member installed on the first layer 14. Additional embodiments for fastener 50 include, but are not limited to, blind rivets, Christmas tree shaped or barbed polymeric material fasteners, and expandable wing-type fasteners. It is preferable that any fastener 50 form a releasable joint when connected to frame cross member 28. This permits removal of insulation panels 12 for repair, replacement, maintenance, and/or cleaning.

[0034] As shown in figure 8, in another embodiment, a pair of insulation panels 70 and 72 are connectably joined at adjoining borders 74 and 76, respectively, in a C-shaped cross member 78. By compressing insulation panels 70 and 72 at their respective borders 74 and 76, connection of the insulation panels 70 and 72 to cross member 78 is accomplished by friction fit, eliminating the need for fasteners, such as fastener 50 shown and described in reference to Figures 6 and 7. Figure 8 also identifies a trim piece 80 which can optionally be inserted at a junction 82 between adjoining borders 74 and 76. Trim piece 80 includes a crowned portion 84 providing a rounded exterior facing surface after installation of trim piece 80, and an engagement portion 86, herein including exemplary barbs 88 which engage at junction 82 between adjoining borders 74 and 76. Trim piece 80 is preferably formed of a polymeric material, but can also be formed of a metal or of composite materials. In another embodiment (not shown) engagement portion 86 of trim piece 80 can be modified to further include male member(s) for releasable engagement with apertures (not shown) in cross member 78. Cross member 78 can also be adapted for vertical installation, allowing similar retention of insulation panels 70 and 72 along adjacent vertical

borders. A member similar to cross member 78 can also be adapted to retain the border of a single insulation panel.

[0035] As best described in Figure 9, method steps are detailed for insulating a compartment of a mobile platform using a one-piece insulated wall of the present invention. In a first step 100, a decorative pattern is formed on a first face of the flexible material layer. In an attaching step 102, the insulation layer is attached to a second face of the flexible material layer. In an orienting step 104, the decorative pattern is oriented toward the interior compartment of the mobile platform. Finally, in a connecting step 106, the insulated wall is connected to the mobile platform having the insulation layer facing an exterior surface of the mobile platform.

[0036] An insulation system of the present invention offers several advantages. By combining the insulation layer(s) with a flexible interior facing layer, insulation can be applied from a rolled coil, which reduces labor during installation. The flexible inner layer of the present invention also replaces the need for mold tooling to develop individual pieces of the inner wall now used on common commercial aircraft. By attaching only perimeter areas of the insulation material to the flexible lining, the coiled insulation panel can be conformed to the shape of an interior surface having curved surfaces or non-linear surfaces without resulting in a wrinkled appearance. By pre-installing fasteners only in the insulation layers, the insulation panel of the present invention can be installed such that fasteners are not visible from a passenger side of the installed insulation panel. Finally, by combining the insulation layer or layers with the flexible material of the present invention, a one-piece simplified removal assembly is provided which affords easy removal of the insulation for maintenance and/or cleaning.

[0037] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention. For example, the mobile platform referred to herein can also include train cars, busses, automobiles, military vehicles, space vehicles, etc. The invention is not limited to the mobile platform type. Although the insulation panel of the present invention is preferably removably installed, at least one border of an insulation panel of the present invention can also be permanently installed without departing from the spirit and scope of the invention.